## Space Weather Forecast

Issued on Friday, 15 September 2023 at 13:05 Local

**This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Moderate Geomagnetic Storm G2 likely late UTC day of Saturday into Sunday. Chance of further Minor Storm G1 Monday. Chance R1 Minor Radio Blackouts throughout.**

### Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has been Moderate in the past 24 hours. There are now up to eight sunspot regions on the facing side of the Sun, and changes in one of these near the middle of the Sun was strongly tied to an increase in the cadence and magnitude of observed flares, with these peaking with two Moderate-class events: at 14/2126UTC and 14/1931UTC. Initially the trend in the group responsible was of proliferation of spots, however this later eased. Other sunspots were generally both simpler and in decay, including all of the remaining three larger magnetically bipolar groups.

**Figure 1: SIDC ROB-derived sources of Common-class X-ray flares and above in the past 24 hours, showing that the most active spot accolade has definitely passed from the northwest (far right) to the centre of the facing side.**

There is a large 'filament' (arc of plasma) lying to the north of the most active sunspot group, in the northeast. This is perhaps therefore more prone to instability should large flares from the active region destabilise its southern end in its 30 degree plus span. Its position near the middle of the Sun and its size mean this is a feature to monitor.

A visually weak Coronal Mass Ejection (CME) seen heading south and east on late UTC evening satellite imagery has an uncertain attribution, however may be linked to the largest flare of the period. This has been modelled and shows a tentative hit of Earth in the UTC morning of Monday 18 September. There was a near-simultaneous large 'disappearing filament' observed from the northwest. This may be tied to an apparently northward-directed slow CME in the early hours of the

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current UTC day - to be confirmed pending further imagery.

**Solar Wind / Geomagnetic Activity:** Solar wind parameters were perhaps most indicative of a possible 'CIR' (Co-rotating Interacting Region - a density increase that precedes some fast wind streams) that did not fully evolve into its associated fast wind - this may be the result of Earth's skirting the southern limits of the driving feature.

The solar wind speed rose from slightly elevated to elevated levels to end the UTC day of 14 September, with the number of particles above average and peaking around 14/1900UTC. This came before a gradual trend downwards in both. The associated magnetic field peaked at a similar time, at slightly elevated levels, while the north-south component showed an overall co-aligned bias (which usually mitigates against geomagnetic effects).

The net effect of the above solar wind measures was narrowly below Minor Geomagnetic Storm G1 at peak.

**Energetic Particles / Solar Radiation:** Solar radiation levels (high energy proton flux) rose slightly to around 0.5pfu at peak (14/1500UTC) in response to the 14/0745UTC Moderate-class X-ray flare from the northwest filament eruption. Minor Solar Radiation Storm levels are significantly above this at 10pfu, and levels have in any case since reverted to resting Background levels.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** There is a daily chance of Moderate-class flares, mainly from the changing sunspot region near the middle of the Sun. The previously active large but fading group in the northwest should leave the Earth-facing side over the coming UTC weekend, but the flare risk may be maintained by the return of another in the east, which may be the source for some large recent far-sided CMEs and, by inference, large flares.

**Solar Wind / Geomagnetic Activity:** The geomagnetic forecast is of lower than average confidence. The main forecast elements are the 14/0745UTC CME (especially), and to a lesser extent the 14/2126UTC CME. An initial slight chance of G1 Minor geomagnetic storm from the 11 September CME and a fast wind will give way to a chance of G2 Moderate geomagnetic storm later in the UTC day of Saturday 16 September, bleeding into Sunday. From here, a further chance of G1 from the 14/2126UTC CME follows on Monday 18 September.

**Energetic Particles / Solar Radiation:** No solar radiation storms are expected.

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**Geomagnetic Storms:**

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 10 | 60 | 40 | 50 |
| Strong | G3 | No | 1 | 10 | 10 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Radio Blackouts - X Ray Flares:**

| X Ray Flares Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | Yes | 50 | 50 | 50 | 50 |
| Very Active | R3 to R5 X | No | 5 | 5 | 5 | 5 |

**Solar Radiation Storms - (High Energy Protons):**

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ S1 | No | 10 | 10 | 10 | 10 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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